

**DEPARTMENT OF CONSUMER AND INDUSTRY SERVICES
DIRECTOR'S OFFICE
OCCUPATIONAL HEALTH STANDARDS—ACRYLONITRILE (AN)**

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(By authority conferred on the director of the department of consumer and industry services by section 24 of 1974 PA 154, MCL 408.1024, and Executive Reorganization Order Nos. 1996-1 and 1996-2, MCL 330.3101 and 445.2001)

R 325.51502, R 325.51509, R 325.51517, R 325.51519, and R 325.51527 of the Michigan Administrative Code are amended as follows:

PART 307. ACRYLONITRILE (AN)

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R 325.51501 Applicability.

Rule 501. (1) These rules apply to all occupational exposures to acrylonitrile (AN), chemical abstracts service registry no. 000107131, except that these rules do not apply to exposures which result solely from the processing, use, and handling of the following materials:

(a) Acrylonitrile-butadiene-styrene resins, Styrene-acrylonitrile resins, nitrile barrier resins, solid nitrile elastomers, and acrylic and modacrylic fibers in the form of finished polymers, including products fabricated from such finished polymers.

(b) Materials made from or containing AN, or both, for which objective data is reasonably relied upon to demonstrate that

the material is not capable of releasing AN in airborne concentrations of more than 1 part per million (ppm) as an 8-hour, time-weighted average under the expected conditions of processing, use, and handling which cause the greatest possible release.

(c) Solid materials made from or containing AN, or both, which will not be heated above 170 degrees Fahrenheit during handling, use, or processing.

(2) An employer who relies on the exemption in subrule (1)(b) of this rule shall maintain records of the objective data supporting that exemption and of the basis of the employer's reliance on the data, as provided in rule 521.

R 325.51502 Definitions.

Rule 502. (1) As used in these rules:

(a) "Acrylonitrile" or "AN" means acrylonitrile monomer, chemical formula $\text{CH}_2=\text{CHCN}$.

(b) "Act" means Act No. 154 of the Public Acts of 1974, as amended, being §408.1001 et seq. of the Michigan Compiled Laws.

(c) "Action level" means a concentration of AN of 1 ppm as an 8-hour, time-weighted average.

(d) "Authorized person" means any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the opportunity to observe monitoring procedures under R 325.51526.

(e) "Decontamination" means the treating of materials and surfaces by water washdown, ventilation, or other means to assure that the materials will not expose an employee to airborne concentrations of AN of more than 1 ppm.

(f) "Director" means the director of the Michigan department of consumer and industry services or his or her designee.

(g) "Emergency" means any occurrence, such as, equipment failure, rupture of containers, or failure of control equipment, which results in an unexpected massive release of AN.

(h) "Liquid AN" means AN monomer in liquid form and liquid or semiliquid polymer intermediates, including slurries, suspensions, emulsions, and solutions which are produced during the polymerization of AN.

(i) "O.H. rule" means an occupational health rule adopted by reference pursuant to section 14 of the act or promulgated pursuant to section 24 of the act. Copies of these rules are available from the Michigan department of consumer and industry services.

R 325.51503 Airborne concentrations; permissible employee exposure limits.

Rule 503. (1) With respect to airborne concentrations, the following limits apply:

(a) An employer shall assure that an employee is not exposed to an airborne concentration of acrylonitrile of more than 2 ppm as an 8-hour, time-weighted average.

(b) An employer shall assure that any employee is not exposed to an airborne concentration of acrylonitrile of more than 10 ppm as averaged over any 15-minute period during the working day.

(2) An employer shall assure that an employee is not exposed to skin contact or eye contact with liquid AN.

R 325.51504 Regulated areas; report of information; emergency report; additional information.

Rule 504. (1) Within 30 days following the establishment of a regulated area pursuant to rule 506, the employer shall report all of the following information to the director:

(a) The address and location of each establishment which has 1 or more regulated areas.

(b) The locations within the establishment which has 1 or more regulated areas.

(c) A brief description of each process or operation which results in employee exposure to AN in a regulated area.

(d) The number of employees engaged in each process or operation within each regulated area which results in exposure to AN, and an estimate of the frequency and degree of exposure that occurs.

(2) If there is a significant change in the information required to be reported by this rule, an employer shall promptly provide the new information to the director.

(3) Emergencies, and the facts obtainable at the time of the emergency, shall be reported to the director within 72 hours of the initial occurrence. Upon request of the director, an employer shall submit additional information in writing relevant to the nature and extent of employee exposures and the measures taken to prevent future emergencies of a similar nature.

R 325.51505 Employee exposure; determination of airborne exposure levels; employer monitoring of airborne concentrations; monitoring exposure below action level; monitoring exposure at or above action level; monitoring exposure of more than permissible limits; additional monitoring; written notice to employee of exposure level; measurement accuracy.

Rule 505. (1) For the purposes of these rules, employee exposure is that exposure which would occur if the employee were not using a respirator.

(2) Determinations of airborne exposure levels shall be made from air samples that are representative of each employee's exposure to AN over an 8-hour period.

(3) An employer who has a place of employment in which AN is present shall monitor each such workplace and work operation to accurately determine the airborne concentrations of AN to which an employee may be exposed.

(4) If the monitoring required by these rules reveals that employee exposure is below the action level, an employer may discontinue monitoring for that employee.

(5) If the monitoring required by these rules reveals that employee exposure is at or above the action level but below the permissible exposure limits, an employer shall repeat such monitoring for each affected employee at least once every 3 months. An employer shall continue these quarterly measurements until not less than 2 consecutive measurements, taken not less than 7 days apart, are below the action level, and thereafter the employer may discontinue monitoring for that employee.

(6) If the monitoring required by these rules reveals that employee exposure is in excess of the permissible exposure limits, an employer shall repeat these determinations for each such employee at least once a month. An employer shall continue these monthly measurements until not less than 2 consecutive measurements, taken not less than 7 days apart, are below the permissible exposure limits, and thereafter an employer shall monitor at least once every 3 months.

(7) If there is a production, process, control, or personnel change which may result in new or additional exposures to AN, additional monitoring that complies with this shall be conducted.

(8) Within 5 working days after the receipt of the results of monitoring required by these rules, an employer shall notify each employee in writing of the results of these rules which represent that employee's exposure.

(9) If the results indicate that the representative employee exposure exceeds the permissible exposure limits, an employer shall include in the written notice a statement that the permissible exposure limits were exceeded and a description of the corrective action being taken to reduce exposure to or below the permissible exposure limits.

(10) The method of measurement of employee exposure shall be accurate to a confidence level of 95% to within plus

or minus 35% for concentrations of AN at or above the permissible exposure limits, and plus or minus 50% for concentrations of AN below the permissible exposure limits.

R 325.51506 Regulated areas; establishment, demarcation and segregation; access; prohibited activities.

Rule 506. (1) An employer shall establish a regulated area where AN concentrations are in excess of the permissible exposure limits.

(2) A regulated area shall be demarcated and segregated from the rest of the workplace in a manner that minimizes the number of persons who will be exposed to AN.

(3) Access to a regulated area shall be limited to authorized persons or to persons who are otherwise authorized by the act or rules promulgated pursuant thereto.

(4) An employer shall assure that neither food nor beverages are present or consumed, that tobacco products are not present or used, and that cosmetics are not applied, in the regulated area.

R 325.51507 Engineering and work practice controls to control employee exposure.

Rule 507. (1) An employer shall institute engineering and work practice controls to reduce and maintain employee exposures to AN at or below the permissible exposure limits, except to the extent that an employer establishes that such controls are not feasible.

(2) If the engineering and work practice controls that can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limits, an employer shall nonetheless use them to reduce exposures to the lowest levels achievable by these controls and shall supplement the controls by the use of respiratory protection which complies with the requirements of rule 509.

R 325.51508 Employee exposure; written program to reduce exposure by means of engineering and work practice controls required; content; completion of program; availability; revision and update.

Rule 508. (1) An employer shall establish and implement a written program to reduce employee exposures to or below the permissible exposure limits solely by means of engineering and work practice controls, as required by rule 507.

(2) A written program shall include, at a minimum, all of the following:

(a) A description of each operation or process resulting in employee exposure to AN above the permissible exposure limits.

(b) An outline of the nature of the engineering controls and work practices to be applied to the operation or process in question.

(c) A report of the technology considered for meeting the permissible exposure limit.

(d) A schedule for implementation of engineering and work practice controls for the operation or process. The schedule shall project completion not later than November 2, 1980.

(e) Other relevant information.

(3) An employer shall complete the steps set forth in the written program by the dates in the schedule.

(4) A written program shall be submitted to the director upon request and shall be available at the worksite for examination and copying by the director or any affected employee or representative.

(5) The written program required by this rule shall be revised and updated at least once every 6 months to reflect the current status of the program.

R 325.51509 Respiratory protection.

Rule 509. (1) For employees who use respirators required by these rules, the employer shall provide respirators that comply with the requirements of this rule. Respirators must be used during:

(a) Periods necessary to install or implement feasible engineering and work practice controls.

(b) Work operations, such as maintenance and repair activities or reactor cleaning, for which the employer establishes that engineering and work practice controls are not feasible.

(c) Work situations for which feasible engineering and work practice controls are not yet sufficient to reduce an employee's exposure to or below the permissible exposure limits.

(d) Emergencies.

(2) Respirator selection. The employer shall select the appropriate respirator from Table 1 of this rule.

(3) Table 1 reads as follows:

Table 1
Respiratory Protection for Acrylonitrile (AN)

Concentration of AN or condition of use	Respirator type
(a) Less than or equal to 20 ppm.	(i) Chemical cartridge respirator with organic vapor cartridge or cartridges and half mask facepiece or (ii) Supplied-air respirator with halfmask facepiece.
(b) Less than or equal to 100 ppm or maximum use concentration (MUC) of cartridges or canisters, whichever is lower.	(i) Full facepiece respirator with any of the following: (A) organic vapor cartridges (B) organic vapor gas mask chin-style (C) organic vapor gas mask canister, front or back mounted. (ii) Supplied-air respirator with full facepiece; or (iii) Self-contained breathing apparatus with full facepiece.
(c) Less than equal to 4,000 ppm.	Supplied-air respirator operated in the positive pressure mode with full facepiece, helmet, suit, or hood.
(d) Greater than 4,000 ppm, or unknown concentration.	(i) Supplied-air and auxiliary self-contained breathing apparatus with full facepiece in positive pressure mode; or (ii) Self-contained breathing apparatus with full facepiece in positive pressure mode.
(e) Firefighting.	Self-contained breathing apparatus with full facepiece in positive pressure mode.
(f) Escape.	(i) Any organic vapor respirator, or (ii) Any self-contained breathing apparatus.

(4) The employer shall implement a respiratory protection program in accordance with 29 CFR 1910.134(b) to (d) and (f) to (m), except for (d)(1)(iii), (d)(3)(iii)(B)(1), and (2), as adopted by reference in R 325.60051 to R 325.60052.

(5) If air-purifying respirators (chemical-cartridge or chemical-canister types) are used, then:

(a) The air-purifying canister or cartridge must be replaced prior to the expiration of its service life or at the completion of each shift, whichever occurs first.

(b) A label must be attached to the cartridge or canister to indicate the date and time at which it is first installed on the respirator.

R 325.51510 Emergency situations; written plans; alarms.

Rule 510. (1) A written plan for emergency situations shall be developed for each workplace where liquid AN is present. Appropriate portions of the plan shall be implemented in the event of an emergency.

(2) The plan shall specifically provide that an employee who is engaged in correcting an emergency condition shall be equipped as required in rule 509 until the emergency has abated.

(3) An employee who is not engaged in correcting the emergency shall be evacuated from the area and shall not be permitted to return until the emergency has abated.

(4) If the possibility of employee exposure to AN in excess of the ceiling limit exists, a general alarm shall be installed and used to promptly alert employees of such occurrences.

R 325.51511 Protective clothing and equipment; provision and use.

Rule 511. Where eye or skin contact with liquid AN might occur, an employer shall provide, at no cost to the employee, and shall assure that employees wear, impermeable protective clothing or other equipment to protect any area of the body that may come in contact with liquid AN. The employer shall comply with the provisions of R 408.13301 to R 408.13398 of the Michigan Administrative Code, which are administered and enforced by the Michigan department of labor.

R 325.51512 Protective clothing and equipment; cleaning and replacement; decontamination; notice to laundering or cleaning persons of potentially harmful effects of exposure to AN.

Rule 512. (1) An employer shall clean, launder, maintain, or replace protective clothing and equipment required by these rules as needed to maintain their effectiveness.

(2) An employer shall assure that impermeable protective clothing that contacts or is likely to have contacted liquid AN is decontaminated before being removed by the employee.

(3) An employer shall assure that an employee whose permeable clothing becomes wetted with liquid AN immediately removes the contaminated clothing and showers. The clothing shall be decontaminated before it is removed from the regulated area.

(4) An employer shall assure that protective clothing or equipment is not removed from the change room, except for the purposes of laundering, maintenance, or disposal.

(5) An employer shall inform any person in writing who launders or cleans protective clothing or equipment of the potentially harmful effects of exposure to AN.

R 325.51513 Hygiene facilities and practices; change rooms; showers.

Rule 513. (1) All surfaces shall be maintained of visible accumulations of liquid AN.

(2) An employer shall institute a program for detecting leaks and spills of liquid AN, including regular visual inspections, for operations involving liquid AN.

(3) If a spill of liquid AN is detected, an employer shall assure that surfaces contacted by the liquid AN are decontaminated. An employee who is not engaged in decontamination activities shall leave the area of the spill and shall not be permitted in the area until decontamination is completed.

(4) AN waste, scrap, debris, bags, containers, or equipment shall be decontaminated before being incorporated in the general waste disposal system.

(5) If an employee is exposed to an airborne concentration of AN above the permissible exposure limit, or if an employee is required to wear protective clothing or equipment pursuant to rule 511, the facilities required by O.H. rule 4201, including clean change rooms and shower facilities, shall be provided by an employer for use by such employees, and the employer shall assure that the employees use the facilities provided.

(6) An employer shall assure that an employee who wears protective clothing or equipment for protection from skin contact with liquid AN showers at the end of the work shift.

(7) An employer shall assure that, in the event of skin or eye exposure to liquid AN, an affected employee showers immediately to minimize the danger of skin absorption.

(8) An employer shall assure that an employee working in the regulated area washes his or her hands and face before eating.

R 325.51514 Medical surveillance program generally.

Rule 514. (1) An employer shall institute a program of medical surveillance for each employee who is or will be exposed to AN at or above the action level, without regard to the use of respirators, and shall provide each such employee with an opportunity for medical examinations and tests pursuant to these rules at the employer's cost.

(2) An employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

R 325.51515 Medical surveillance program; initial examinations.

Rule 515. (1) At the time of initial assignment, or upon institution of the medical surveillance program, an employer shall provide each affected employee with an opportunity for a medical examination, including, at a minimum, all of the following elements:

(a) A work history and medical history with special attention to skin, respiratory, and gastrointestinal systems, and those nonspecific symptoms, such as headache, nausea, vomiting, dizziness, weakness, or other central nervous system dysfunctions, which may be associated with acute or chronic exposure to AN.

(b) A complete physical examination with special attention to the peripheral and central nervous system, gastrointestinal system, respiratory system, skin, and thyroid.

(c) A 14-inch by 17-inch posterior-anterior chest x ray.

(d) Further tests of the intestinal tract, including fecal occult blood screening, for all workers 40 years of age or older and other affected employees for whom, in the opinion of the physician, such testing is appropriate.

R 325.51516 Medical surveillance program; periodic and additional examinations.

Rule 516. (1) An employer shall provide the examinations specified in rule 515 at least annually for all employees specified in rule 514.

(2) If an employee has not had the examination specified in rule 515 within 6 months preceding termination of employment, an employer shall make such examination available to the employee before termination.

(3) If for any reason an employee develops signs or symptoms which may be associated with exposure to AN, an employer shall provide an appropriate examination and emergency medical treatment.

R 325.51517 Medical surveillance program; information provided to physician by employer.

Rule 517. An employer shall provide all of the following information to the examining physician:

(a) A copy of these rules and related appendices which may be obtained from the department of consumer and industry services.

(b) A description of an affected employee's duties as they relate to the employee's exposure.

(c) The employee's representative exposure level.

(d) The employee's anticipated or estimated exposure level for preplacement examinations or for cases of exposure due to an emergency.

(e) A description of any personal protective equipment used or to be used.

(f) Information from previous medical examinations of the affected employee which is not otherwise available to the examining physician.

R 325.51518 Medical surveillance program; physician's written opinion.

Rule 518. (1) An employer shall obtain a written opinion from the examining physician which shall include all of the following:

(a) The results of the medical examination and tests performed.

(b) The physician's opinion as to whether an employee has any detected medical condition or conditions which would subject the employee to an increased risk of material health impairment from exposure to AN.

(c) Any recommended limitations upon the employee's exposure to AN or upon the use of protective clothing and equipment such as a respirator.

(d) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(2) An employer shall instruct the physician not to reveal specific findings or diagnoses unrelated to occupational exposure to AN in the written opinion.

(3) An employer shall provide a copy of the written opinion to the affected employee.

R 325.51519 Employee information and training program; applicability; provision of information to employees; availability of rules and other materials to employees and director.

Rule 519. (1) An employer shall institute a training and information program for, and assure the participation of, all employees exposed to AN above the action level, all employees whose exposures are maintained below the action level by engineering and work practice controls, and all employees subject to potential skin or eye contact with liquid AN.

(2) Training shall be provided at the time of initial assignment or upon institution of the training program and at least once annually thereafter.

(3) The employer shall assure that each employee is informed of all of the following:

(a) The information contained in appendices A and B of these rules. Appendices A and B are available from the department of consumer and industry services.

(b) The quantity, location, manner of use, release, or storage of AN, and the specific nature of operations which could result in exposure to AN, as well as any necessary protective steps.

(c) The purpose, proper use, and limitations of respirators and protective clothing.

(d) The purpose and a description of the medical surveillance program required by these rules.

(e) The emergency procedures developed, as required by R 325.51510.

(f) Engineering and work practice controls, their function, and an employee's relationship to these controls.

(g) A review of these rules.

(4) An employer shall make a copy of these rules and appendices readily available to all affected employees.

(5) Upon request, an employer shall provide all materials relating to the employee information and training program to the director.

R 325.51520 Workplace warning signs and labels; employer responsibilities.

Rule 520. (1) An employer shall post signs to clearly indicate all workplaces where AN concentrations exceed the permissible exposure limits. The signs shall bear the following legend:

DANGER
ACRYLONITRILE (AN)
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS MAY BE REQUIRED

(2) An employer shall assure that signs required by this rule are illuminated and cleaned as necessary so that the legend is readily visible.

(3) An employer shall assure that precautionary labels are affixed to all containers of liquid AN and AN-based materials which are not exempted under rule 501 and shall assure that the labels remain affixed when the materials are sold, distributed, or otherwise leave the employer's workplace.

(4) An employer shall assure that the precautionary labels required by this rule are readily visible and legible. The labels shall bear the following legend:

DANGER
CONTAINS ACRYLONITRILE (AN)
CANCER HAZARD

(5) An employer shall assure that statements do not appear on or near any sign or label required by this rule which contradict or detract from the required sign or label.

(6) An employer may use labels or signs required by other statutes, rules, or ordinances in addition to, or in combination with, signs and labels required by this rule.

R 325.51521 Operations exempted under rule 501; records of objective data required; maintenance.

Rule 521. (1) If the processing, use, and handling of materials made from or containing AN are exempted pursuant to rule 501, an employer shall establish and maintain an accurate record of the objective data reasonably relied upon in support of the exemption which shall include, at a minimum, all of the following information:

- (a) The material qualifying for exemption.
- (b) The source of the objective data.
- (c) The testing protocol and the results of the testing or an analysis of the material, or both, for the release of AN.
- (d) A description of the operation exempted and how the data supports the exemption.
- (e) Other data relevant to the operations, materials, and processing covered by the exemption.

(2) An employer shall maintain this record for the duration of the employer's reliance upon such objective data.

R 325.51522 Monitoring of exposure; records; maintenance.

Rule 522. (1) An employer shall establish and maintain an accurate record of all monitoring required by rule 505. The exposure monitoring record shall include all of the following:

- (a) The dates, number, duration, and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure.
- (b) A description of the sampling and analytical methods used and the data relied upon to establish that the methods used meet the accuracy and precision requirements of rule 505(10).
- (c) Type of respiratory protective devices worn, if any.
- (d) Name, social security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent.

(2) An employer shall maintain this record for not less than 40 years or for the duration of employment plus 20 years, whichever is longer.

R 325.51523 Medical surveillance records; maintenance.

Rule 523. (1) An employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by rules 514 to 516. The medical surveillance record shall include all of the following:

- (a) A copy of the physician's written opinion.
- (b) Any employee medical complaints related to exposure to AN.
- (c) A copy of the information provided to the physician as required by rule 517.
- (d) A copy of the employee's medical and work history.

(2) An employer shall assure that this record is maintained for not less than 40 years or the duration of employment plus 20 years, whichever is longer.

R 325.51524 Availability of records.

Rule 524. (1) Upon request, an employer shall make all records that are required to be maintained by these rules available to the director for examination and copying.

(2) Upon request, an employer shall make records that are required to be maintained by R 325.51521 to R 325.51523 available to affected employees, former employees, or their designated representatives for examination and copying in accordance with the provisions of R 325.3451 et seq. of the Michigan Administrative Code.

(3) Records that are required pursuant to the provisions of R 325.51521 shall be provided in the same manner as exposure monitoring records.

R 325.515125 Retention and disposal of records; successor employer; transmittal and notice to director.

Rule 525. (1) If an employer ceases to do business, then the successor employer shall receive and retain all records that are required to be maintained by these rules for the prescribed period.

(2) If an employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, then these records shall be transmitted to the director.

(3) At the expiration of the retention period for the records that are required to be maintained pursuant to these rules, an employer shall notify the director not less than 3 months before the disposal of the records and shall transmit the records to the director upon request.

(4) The transfer of records and notification to employees shall be accomplished in accordance with the provisions of R 325.3475.

R 325.51526 Exposure monitoring; employee observation.

Rule 526. (1) An employer shall provide affected employees or their designated representatives with an opportunity to observe any monitoring of employee exposure to AN which is conducted pursuant to rule 505.

(2) If the observation of the monitoring of employee exposure to AN requires entry into an area where the use of protective clothing or personal protective clothing and equipment required to be worn by employees working in the area, shall assure the use of such clothing and equipment, and shall require the observer to comply with all other applicable safety and health procedures.

(3) If the monitoring is not interfered with, observers shall be entitled to all of the following:

- (a) To receive an explanation of the measurement procedures.
- (b) To observe all steps related to the measurement of airborne concentrations of AN performed at the place of exposure.
- (c) To record the results obtained.

R 325.51527 Availability of rules and appendices; permission to reproduce.

Rule 527. (1) A copy of these rules and related appendices entitled: "Appendix A—Substance Safety Data Sheet," "Appendix B—Substance Technical Information," "Appendix C—Medical Surveillance Information for Acrylonitrile," and "Appendix D—Sampling and Analytical Methods for Acrylonitrile" are available to affected employers and employees at no cost from the Michigan Department of Consumer and Industry Services, Standards Division, P.O. Box 30643, Lansing, Michigan 48909.

(2) Permission to reproduce any of these documents in full is granted by the director.

**APPENDICES TO MIOSHA STANDARD FOR
ACRYLONITRILE (AN)
(R 325.51501 - R 325.51527)**

APPENDIX A—SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

A. Substance: Acrylonitrile ($\text{CH}_2=\text{CHCN}$); CAS No. 107-13-1

B. Synonyms: Propenenitrile; vinyl cyanide; cyanoethylene; AN; VCN; acrylon; carbacryl; fumigrain; ventox.

C. Acrylonitrile can be found as a liquid or vapor, and can also be found in polymer resins, rubbers, plastics, polyols, and other polymers having acrylonitrile as a raw or intermediate material.

D. AN is used in the manufacture of acrylic and modiacrylic fibers, acrylic plastics and resins, specialty polymers, nitrile rubbers, and other organic chemicals. It has also been used as a fumigant.

E. Appearance and odor: Colorless to pale yellow liquid with a pungent odor which can only be detected at concentrations above the permissible exposure level, in a range of 13-19 parts AN per million parts of air (13-19 ppm).

F. Permissible exposure: Exposure may not exceed either:

1. Two parts AN per million parts of air (2 ppm) averaged over the 8-hour workday; or
2. Ten parts AN per million parts of air (10 ppm) averaged over any 15-minute period in the workday.
3. In addition, skin and eye contact with liquid AN is prohibited.

II. HEALTH HAZARD DATA

A. Acrylonitrile can affect your body if you inhale the vapor (breathing), if it comes in contact with your eyes or skin, or if you swallow it. It may enter your body through your skin.

B. Effects of overexposure:

1. Short-term exposure: Acrylonitrile can cause eye irritation, nausea, vomiting, headache, sneezing, weakness, and light-headedness. At high concentrations the effects of exposure may go on to loss of consciousness and death. When acrylonitrile is held in contact with the skin after being absorbed into shoe leather or clothing, it may produce blisters following several hours of no apparent effect. Unless the shoes or clothing are removed immediately and the area washed, blistering will occur. Usually there is no pain or inflammation associated with blister formation.

2. Long-term exposure: Acrylonitrile has been shown to cause cancer in laboratory animals and has been associated with higher incidences of cancer in humans. Repeated or prolonged exposure of the skin to acrylonitrile may produce irritation and dermatitis.

3. Reporting signs and symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to acrylonitrile.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye exposure: If acrylonitrile gets into your eye, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention

immediately. Contact lenses should not be worn when working with this chemical.

B. Skin exposure: If acrylonitrile gets on your skin, immediately wash the contaminated skin with water. If acrylonitrile soaks through your clothing, especially your shoes, remove the clothing immediately and wash the skin with water. If symptoms occur after washing, get medical attention immediately. Thoroughly wash the clothing before reusing. Contaminated leather shoes or other leather articles should be discarded.

C. Inhalation: If you or any other person breathes in large amounts of acrylonitrile, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

D. Swallowing: When acrylonitrile has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

E. Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of the emergency equipment before the need arises.

F. Special first aid procedures: First aid kits containing an adequate supply (at least two dozen) of amyl nitrite pearls, each containing 0.2 ml, should be maintained at each site where acrylonitrile is used. When a person is suspected of receiving an overexposure to acrylonitrile, immediately remove that person from the contaminated area using established rescue procedures. Contaminated clothing must be removed and the acrylonitrile washed from the skin immediately. Artificial respiration should be started at once if breathing has stopped. If the person is unconscious, amyl nitrite may be used as an antidote by a properly trained individual in accordance with established emergency procedures. Medical air should be obtained immediately.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: You may be required to wear a respirator for nonroutine activities, in emergencies, while your employer is in the process of reducing acrylonitrile exposures through engineering controls, and in areas where engineering controls are not feasible. If respirators are worn, they must have a label issued by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR Part 84 stating that the respirators have been approved for use with organic vapors. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required.

Acrylonitrile does not have a detectable odor except at levels above the permissible exposure limits. Do not depend on odor to warn you when a respirator cartridge or canister is exhausted. Cartridges or canisters must be changed daily or before the end-of-service-life, whichever comes first. Reuse of these may allow acrylonitrile to gradually filter through the cartridge and cause exposures which you cannot detect by odor. If you can smell acrylonitrile while wearing a respirator, proceed immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Supplied-air suits: In some work situations, the wearing of supplied-air suits may be necessary. Your employer must instruct you in their proper use and operation.

C. Protective clothing: You must wear impervious clothing, gloves, face shield, or other appropriate protective clothing to prevent skin contact with liquid acrylonitrile. Where protective clothing is required, your employer is required to provide clean garments to you as necessary to assure that the clothing protects you adequately.

Replace or repair impervious clothing that has developed leaks.

Acrylonitrile should never be allowed to remain on the skin. Clothing and shoes which are not impervious to acrylonitrile should not be allowed to become contaminated. If they do, the clothing and shoes should be promptly removed and decontaminated. The clothing should be laundered or discarded after the AN is removed. Once acrylonitrile penetrates shoes or other leather articles, they should not be worn again.

D. Eye protection: You must wear splashproof safety goggles in areas where liquid acrylonitrile may contact your eyes. In addition, contact lenses should not be worn in areas where eye contact with acrylonitrile can occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

A. Acrylonitrile is a flammable liquid, and its vapors can easily form explosive mixtures in air.

B. Acrylonitrile must be stored in tightly closed containers in a cool, well-ventilated area, away from heat, sparks, flames, strong oxidizers (especially bromine), strong bases, copper, copper alloys, ammonia, and amines.

C. Sources of ignition such as smoking and open flames are prohibited wherever acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard.

D. You should use non-sparking tools when opening or closing metal containers of acrylonitrile, and containers must be bonded and grounded when pouring or transferring liquid acrylonitrile.

E. You must immediately remove any nonimpervious clothing that becomes wetted with acrylonitrile, and this clothing must not be reworn until the acrylonitrile is removed from the clothing.

F. Impervious clothing wet with liquid acrylonitrile can be easily ignited. This clothing must be washed down with water before you remove it.

G. If your skin becomes wet with liquid acrylonitrile, you must promptly and thoroughly wash or shower with soap or mild detergent to remove any acrylonitrile from skin.

H. You must not keep food, beverages or smoking materials, nor are you permitted to eat or smoke in regulated areas where acrylonitrile concentrations are above the permissible exposure limits.

I. If you contact liquid acrylonitrile, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

J. Fire extinguishers and quick drenching facilities must be readily available, and you should know where they are and how to operate them.

K. Ask your supervisor where acrylonitrile is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year, your employer is required to inform you of the information contained in this Substance Safety Data Sheet for acrylonitrile. In addition, your employer must instruct you in the proper work practices for using acrylonitrile, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to acrylonitrile. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits.

C. Your employer is required to keep records of your exposures and medical examinations. These records must be kept by the employer for at least forty (40) years or for the period of your employment plus twenty (20) years, whichever

is longer. D. Your employer is required to release your exposure and medical records to you or your representative upon your request.

(See Appendix B for fire, reactivity, spill, protective clothing, monitoring, housekeeping, and other procedures.)

APPENDIX B—SUBSTANCE TECHNICAL INFORMATION

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification: Acrylonitrile; CAS No. 107-13-1

1. Synonyms: AN; VCN; vinyl cyanide; propenenitrile; cyanoethylene; Acrylon; Carbacryl; Fumigrain; Ventox.

2. Formula: $\text{CH}_2=\text{CHCN}$.

3. Molecular weight: 53.1.

B. Physical data:

1. Boiling point (760 mm Hg): 77.3°C (171°F).

2. Specific gravity (water=1): 0.81 (at 20°C or 68°F).

3. Vapor density (air=1 at boiling point of acrylonitrile): 1.83.

4. Melting point: -83°C (-117°F).

5. Vapor pressure (at 20°F): 83 mm Hg.

6. Solubility in water, % by weight at 20°C (68°F): 7.35.

7. Evaporation rate (Butyl Acetate=1): 4.54.

8. Appearance and odor: Colorless to pale yellow liquid with a pungent odor at concentrations above the permissible exposure level. Any detectable odor of acrylonitrile may indicate overexposure.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire:

1. Flash point: -1°C (30°F) (closed cup).

2. Autoignition temperature: 481°C (898°F).

3. Flammable limits air, percent by volume: Lower: 3, Upper: 17.

4. Extinguishing media: Alcohol foam, carbon dioxide, and dry chemical.

5. Special fire-fighting procedures: Do not use a solid stream of water because the stream will scatter and spread the fire. Use water to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Acrylonitrile is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard.

Acrylonitrile vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which acrylonitrile is being handled.

7. For purposes of compliance with the requirements of 29 CFR 1910.106, acrylonitrile is classified as a class IB flammable liquid. For example, 7,500 ppm, approximately one-fourth of the lower flammable limit, would be considered to pose a potential fire and explosion hazard.

8. For purposes of compliance with Part 8, Portable Fire Extinguishers, of MIOSHA Safety Standards for General Industry, acrylonitrile is classified as a Class B fire hazard.

9. For purpose of compliance with 29 CFR 1919.309, locations classified as hazardous due to the presence of acrylonitrile shall be Class I, Group D.

B. Reactivity:

1. Conditions contributing to instability: Acrylonitrile will polymerize when hot, and the additional heat liberated by the polymerization may cause containers to explode. Pure AN may self-polymerize, with a rapid build-up of pressure, resulting in an explosion hazard. Inhibitors are added to the commercial product to prevent self-polymerization.

2. Incompatibilities: Contact with strong oxidizers (especially bromine) and strong bases may cause fires and explosions.

Contact with copper, copper alloys, ammonia, and amines may start serious decomposition.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide, oxides of nitrogen, and carbon monoxide) may be released in a fire involving acrylonitrile and certain polymers made from acrylonitrile.

4. Special precautions: Liquid acrylonitrile will attack some forms of plastics, rubbers, and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If acrylonitrile is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. The area should be evacuated at once and re-entered only after the area has been thoroughly ventilated and washed down with water.

3. If liquid acrylonitrile or polymer intermediate, collect for reclamation or absorb in paper, vermiculite, dry sand, earth, or similar material, or wash down with water into process sewer system.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until clean-up has been completed.

C. Waste disposal methods: Waste material shall be disposed of in a manner that is not hazardous to employees or to the general population.

Spills of acrylonitrile and flushing of such spills shall be channeled for appropriate treatment or collection for disposal. They shall not be channeled directly into the sanitary sewer system. In selecting the method of waste disposal, applicable local, State, and Federal regulations shall be consulted.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure above the Permissible Exposure Limit:

1. Eight-hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken so that the average 8-hour exposure may be determined from a single 8-hour sample or two (2) 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee.)

2. Ceiling evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of acrylonitrile in the employee's breathing zone. A minimum of three (3) measurements should be taken on one work shift. The average of all measurements is an estimate of the employee's ceiling exposure.

3. Monitoring techniques: The sampling and analysis under this section may be performed by collecting the acrylonitrile vapor on charcoal absorption tubes or other composition absorption tubes, with subsequent chemical analysis. Sampling and analysis may also be performed by instruments such as real-time continuous monitoring systems, portable direct-reading instruments, or passive dosimeters. Analysis of resultant samples should be by gas chromatograph.

Appendix D lists methods of sampling and analysis which have been tested by NIOSH and OSHA for use with acrylonitrile. NIOSH and OSHA have validated modifications of NIOSH Method S-156 (See Appendix D) under laboratory conditions for concentrations below 1 ppm. The employer has the obligation of selecting a monitoring method which meets the accuracy and precision requirements of the standard under his unique field conditions. The standard requires that methods of monitoring must be accurate, to a 95-percent confidence level, to +35-percent for concentrations of AN at or above 2 ppm, and to +50-percent for concentrations below 2 ppm. In addition to the methods described in Appendix D, there are numerous other methods available for monitoring for AN in the workplace. Details on these other methods have been submitted by various

companies to the rulemaking record, and are available at the OSHA Docket Office.

B. Since many of the duties relating to employee exposure are dependent on the results of monitoring and measuring procedures, employers shall assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. PROTECTIVE CLOTHING

Employees shall be provided with and required to wear appropriate protective clothing to prevent any possibility of skin contact with liquid AN.

Because acrylonitrile is absorbed through the skin, it is important to prevent skin contact with liquid AN. Protective clothing shall include impermeable coveralls or similar full-body work clothing, gloves, head-coverings, as appropriate to protect areas of the body which may come in contact with liquid AN.

Employers should ascertain that the protective garments are impermeable to acrylonitrile. Nonimpermeable clothing and shoes should not be allowed to become contaminated with liquid AN. If permeable clothing does become contaminated, it should be promptly removed, placed in a regulated area for removal of the AN, and not worn again until the AN is removed. If leather footwear or other leather garments become wet from acrylonitrile, they should be replaced and not worn again, due to the ability of leather to absorb acrylonitrile and hold it against the skin. Since there is no pain associated with the blistering which may result from skin contact with liquid AN, it is essential that the employer be informed of this hazard so that he or she can be protected.

Any protective clothing which has developed leaks or is otherwise found to be defective shall be repaired or replaced. Clean protective clothing shall be provided to the employee as necessary to assure its protectiveness. Whenever impervious clothing becomes wet with liquid AN, it shall be washed down with water before being removed by the employee. Employees are also required to wear splash-proof safety goggles where there is any possibility of acrylonitrile contacting the eyes.

VI. HOUSEKEEPING AND HYGIENE FACILITIES.

For purposes of complying with Occupational Health Rule 4201, Sanitation, the following items should be emphasized:

A. The workplace should be kept clean, orderly, and in a sanitary condition. The employer is required to institute a leak and spill detection program for operations involving liquid AN in order to detect sources of fugitive AN emissions.

B. Dry sweeping and the use of compressed air is unsafe for the cleaning of floors and other surfaces where liquid AN may be found.

C. Adequate washing facilities with hot and cold water are to be provided and maintained in a sanitary condition. Suitable cleansing agents are also to be provided to assure the effective removal of acrylonitrile from the skin.

D. Change or dressing rooms with individual clothes storage facilities must be provided to prevent the contamination of street clothes with acrylonitrile. Because of the hazardous nature of acrylonitrile, contaminated protective clothing should be placed in a regulated area designated by the employer for removal of the AN before the clothing is laundered or disposed of.

VII. MISCELLANEOUS PRECAUTIONS

A. Store acrylonitrile in tightly-closed containers in a cool, well-ventilated area and take necessary precautions to avoid any explosion hazard.

B. High exposure to acrylonitrile can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring.

D. Never store uninhibited acrylonitrile.

E. Acrylonitrile vapors are not inhibited. They may form polymers and clog vents of storage tanks.

F. Use of supplied-air or other impervious coverings may be necessary to prevent skin contact with and provide respiratory protection from acrylonitrile where the concentration of acrylonitrile is unknown or is above the ceiling limit. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits.

G. Employers shall advise employees of all areas and operations where exposure to acrylonitrile could occur.

VIII. COMMON OPERATIONS

Common operations in which exposure to acrylonitrile is likely to occur include the following: Manufacture of the acrylonitrile monomer; synthesis of acrylic fibers, ABS, SAN, nitrile barrier plastics and resins, nitrile rubber, surface coatings, and specialty chemicals; use as a chemical intermediate; use as a fumigant; and in the cyanoethylation of cotton.

APPENDIX C—MEDICAL SURVEILLANCE INFORMATION FOR ACRYLONITRILE

I. ROUTE OF ENTRY

Inhalation; skin absorption; ingestion.

II. TOXICOLOGY

Acrylonitrile vapor is an asphyxiant due to inhibitory action on metabolic enzyme systems. Animals exposed to 75 or 100 ppm for 7 hours have shown signs of anoxia; in some animals which died at the higher level, cyanomethemoglobin was found in the blood. Two human fatalities from accidental poisoning have been reported; one was caused by inhalation of an unknown concentration of the vapor, and the other was thought to be caused by skin absorption or inhalation. Most cases of intoxication from industrial exposure have been mild, with rapid onset of eye irritation, headache, sneezing, and nausea. Weakness, lightheadedness, and vomiting may also occur. Exposure to high concentrations may produce profound weakness, asphyxia, and death. The vapor is a severe eye irritant. Prolonged skin contact with the liquid may result in absorption with systemic effects, and in the formation of large blisters after a latent period of several hours. Although there is usually little or no pain or inflammation, the affected skin resembles a second-degree thermal burn. Solutions spilled on exposed skin, or on areas covered only by a light layer of clothing, evaporate rapidly, leaving no irritation, or, at the most, mild transient redness. Repeated spills on exposed skin may result in dermatitis due to solvent effects.

Results after 1 year of a planned 2-year animal study on the effects of exposure to acrylonitrile have indicated that rats ingesting as little as 35 ppm in their drinking water develop tumors of the central nervous system. The interim results of this study have been supported by a similar study being conducted by the same laboratory, involving exposure of rats by inhalation of acrylonitrile vapor, which has shown similar types of tumors in animals exposed to 80 ppm.

In addition, the preliminary results of an epidemiological study being performed by DuPont on a cohort of workers in their Camden, S.C. acrylic fiber plant indicate a statistically significant increase in the incidence of colon and lung cancers among employees exposed to acrylonitrile.

III. SIGNS AND SYMPTOMS OF ACUTE OVEREXPOSURE

Asphyxia and death can occur from exposure to high concentrations of acrylonitrile. Symptoms of overexposure include eye irritation, headache, sneezing, nausea and vomiting, weakness, and light-headedness. Prolonged skin contact can

cause blisters on the skin with appearance of a second-degree burn, but with little or no pain. Repeated skin contact may produce scaling dermatitis.

IV. TREATMENT OF ACUTE OVEREXPOSURE

Remove employee from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If AN has been swallowed, and person is conscious, induce vomiting. Give artificial resuscitation if indicated.

More severe cases, such as those associated with loss of consciousness, may be treated by the intravenous administration of sodium nitrate, followed by sodium thiosulfate, although this is not as effective for acrylonitrile poisoning as for inorganic cyanide poisoning.

V. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. As noted above, exposure to acrylonitrile has been linked to increased incidence of cancers in the colon and lung in employees of the DuPont acrylic fiber plant in Camden, S.C. In addition, the animal testing of acrylonitrile has resulted in the development of cancers of the central nervous system in rats exposed by either inhalation or ingestion. The physician should be aware of the findings of these studies in evaluating the health of employees exposed to acrylonitrile.

Most reported acute effects of occupational exposure to acrylonitrile are due to its ability to cause tissue anoxia and asphyxia. The effects are similar to those caused by hydrogen cyanide. Liquid acrylonitrile can be absorbed through the skin upon prolonged contact. The liquid readily penetrates leather, and will produce burns of the feet if footwear contaminated with acrylonitrile is not removed.

It is important for the physician to become familiar with the operating conditions in which exposures to acrylonitrile may occur. Those employees with skin diseases may not tolerate the wearing of protective clothing necessary to protect them from exposure. In addition, those with chronic respiratory disease may not tolerate the wearing of negative-pressure respirators.

B. Surveillance and screening. Medical histories and laboratory examinations are required for each employee subject to exposure to acrylonitrile above the action level. The employer must screen employees for history of certain medical conditions which might place the employee at increased risk from exposure.

1. Central nervous system dysfunction. Acute effects of exposure to acrylonitrile generally involve the central nervous system. Symptoms of acrylonitrile exposure include headache, nausea, dizziness, and general weakness. The animal studies cited above suggest possible carcinogenic effects of acrylonitrile on the central nervous system, since rats exposed by either inhalation or ingestion have developed similar CNS tumors.

2. Respiratory disease. The DuPont data indicate an increased risk of lung cancer among employees exposed to acrylonitrile.

3. Gastrointestinal disease. The DuPont data indicate an increased risk of cancer of the colon among employees exposed to acrylonitrile. In addition, the animal studies show possible tumor production in the stomachs of the rats of the ingestion study.

4. Skin disease. Acrylonitrile can cause skin burns when prolonged skin contact with the liquid occurs. In addition, repeated skin contact with the liquid can cause dermatitis.

5. General. The purpose of the medical procedures outlined in the standard is to establish a baseline for future health monitoring. Persons unusually susceptible to the effects of anoxia or those with anemia would be expected to be at increased risk. In addition to emphasis on the CNS, respiratory and gastro-intestinal systems, the cardiovascular system, liver, and kidney function should also be stressed.

APPENDIX D—SAMPLING AND ANALYTICAL METHODS FOR ACRYLONITRILE

A number of methods are available for monitoring employee exposures to acrylonitrile. Many of these involve the use of charcoal tubes and sampling pumps, followed by analysis of the samples by gas chromatograph. Differences among the charcoal tube methods include desorbing solvents and analytical equipment.

Besides these methods, others include passive dosimeters and detector tubes to determine exposure to acrylonitrile. Additionally, there are several commercially available portable gas analyzers and monitoring units.

Two primary sources of validated analytical methods for acrylonitrile analysis are Federal OSHA and NIOSH. OSHA publishes their methods in the OSHA Analytical Methods

Manual, which is available from the American Conference of Governmental Industrial Hygienists Inc. (ACGIH) at (513) 661-7881. A single copy of an individual method may be obtained from the OSHA Salt Lake City Analytical Laboratory (SLCAL) at (801) 524-5287. NIOSH methods are compiled in the NIOSH Manual of Analytical Methods. For NIOSH publications, call (513) 841-4287. A summary of methods included in the two manuals are in Table 1.

If employers note problems with sample breakthrough using charcoal methods, they should try larger charcoal tubes, lower flow rates, or shorter sampling times. Whatever method chosen, the employer is responsible for validating the method's accuracy and precision under the unique conditions present in the workplace.

TABLE 1—FEDERAL OSHA AND NIOSH METHODS FOR ACRYLONITRILE

Analytical Method	OSHA 37	NIOSH 1604
Matrix:	Air	Air
Rec. Sampling Rate:	0.2 L/min. (0.5 L/min for ceiling)	0.01 to 0.2 L/min.
Rec. Air Volume:	20 L (7.5 L/min. for ceiling)	3.5 to 20 L
Sample Medium:	100/50 mg charcoal tube	100/50 mg charcoal tube
Desorbing Solvent:	Acetone	2% acetone in CS ₂ (V/V)
Analysis:	Gas chromatograph w/nitrogen/phosphorus detector	Gas chromatograph w/flame ionization detector
Estimated Limit of Detection:	0.012 ppm (0.026 mg/m ³) based on 20 L	0.023 ppm (0.05 mg/m ³) based on 20 L